THE MORPHOLOGY OF BACTERIA.

Contribution à l'Étude de la Morphologie et du Développement des Bactériacées. Par A. Billet, Doct. en Méd., Médecin-Major de 2e classe. (Paris: Octave Doin.)

SINCE the publication of the "Peach-coloured Bacterium," by Prof. Lankester, the subject of the morphology of the bacteria cannot be said to have received much attention from English investigators. The department of bacteriology has to a great extent been monopolised by the physician, who appears to confine himself almost exclusively to the study of the more practical bearings of the subject. It is therefore refreshing to find a surgeon-major devoting his time to a very thorough investigation of bacterial morphology.

Dr. Billet's work dates back from 1885, and was carried on for the most part in the Wimereux Laboratory under the able direction of Prof. Giard. His communications were first published in the *Bul. Sc. de la France et de la Belgique*, and the present work is a collected and revised edition of these. The work consists of some 287 pages, and includes (1) an historical introduction, which, owing to its succinctness and chronological sequence, will be found of great use to the general bacteriologist; (2) a minute description of the life histories of *Cladothrix dichotoma* and *Bacterium parasiticum*, and of two new species named by Dr. Billet, *Bacterium Balbiani* and *Bacterium osteophilum*; (3) a very large bibliographical index embracing some 662 references; (4) a very beautiful series of drawings.

The author briefly sketches the progress of morphology from the time of the doctrine of immutability of Cohn and that of pleomorphism of Prof. Lankester, Cienkowski, and Zopf. He shows how C. Robin (1847), in his wonderfully interesting work, pointed to an affinity between certain bacteria, his *Leptothrix baccalis*, for instance, and certain filamentous algæ, the Leptothrix of Kützing (1843); how, after the lapse of twenty-six years, Prof. Lankester (1873 and 1876), determined, in his well-known *Bacterium rubescens*, the coexistence of micrococcal, bacillary, and spirillar forms; and finally, how the theory of the "form phases" became further elucidated by Cienkowski in 1887 in the "Morphologie der Bakterien," and by Zopf in 1871 in his "Genetische Zusammenhang von Spaltpilzformen." The latter observer describes in the life history of the higher bacteria, coccal, bacteroid, bacillary, vibrio, spirillar, leptothrix, and zooglea forms; the *Clathrocystis roseo-persicina* of Cohn becomes the zooglea phase described in *Bacterium rubescens* of Lankester, or more correctly, of the higher *Beggintoa roseo-persicina*. Starting with the above series of form phases, the author ingeniously consolidates and groups them into four stages, viz.:—1. The *filamentous*, in which the bacteria are associated into larger and shorter filaments. 2. The *dissociated* stage in which the elements become free and motile, and assume the well-known coccal bacteroid and other forms. 3. The *interlacing* stage—*état enchevêtré*—where the elements interlace with one another. 4. A *zooglea* stage, in which the elements loose their movements and aggregate themselves into certain definite forms. The author goes on to show how definite and characteristic are these groupings in the case of the organisms which he has examined (see above). He points out that their presence or absence depends upon surrounding conditions—media, temperature, &c. But he further widens the whole question in seeking to show that in the less highly developed bacteria there are traces of the form phases and form groupings of the more morphologically perfect organisms. In this connection he briefly brings together the observations which have been made upon the life history of the lower bacteria. Thus the encapsulation observed in the pneumococci, streptococci, tubercle, and anthrax bacilli, sarcinæ, &c., &c., may correspond to the zooglea stage, for he recognises both pneumococcal, merispomedia, and sarcina forms in his zooglea stage. He regards the zooglea as protective, and forming when the medium is becoming exhausted. We may add that in the animal tissues encapsulation often appears dependent upon the resistance offered by the tissues. He further points out that the zooglea is often pigmented.

In describing the life histories of his bacteria, Dr. Billet makes some interesting remarks. Thus, he is inclined to believe that the cilium of the vibrio form is nothing else than the residuum of the inner coat, and that it is formed during the process of segmentation by a drawing out and attenuation of the inner coat, like, for example, when a glass rod is drawn out in a flame. As many vibrios move about which have no cilia, he agrees with Van Zieghem that the bacterial element has a proper movement of its own, which is not dependent upon a cilium, and he believes that the cilium of the Bacteria is quite a different thing from the cilium of zoospores. He carefully describes the movements of the vibrio forms, and adds that they are greatly accentuated by a powerful light, a point first observed by Engelmann, in his *Bacterium photometricum*. He also states that the passage from the rectilinear forms to the less curved (vibrio) and more curved (spirilla) forms, depends upon the degree of temperature and amount of putrefaction; the greater the latter the more the twisted and appendiculate forms. He concludes by giving the evidence in favour of a relationship between the Bacteria and the Algæ; the relationship appears great in the case of the organisms which he describes, but probably if he had studied Actinomyces he might have similarly found very many points in favour of a relationship with the mycelial fungi.

RUBERT BOYCE.

OUR BOOK SHELF.

Introductory Modern Geometry of Point, Ray, and Circle. By W. B. Smith. (London: Macmillan and Co., 1893.)

THIS work of Prof. Smith's has a "very practical purpose," viz. "to present in simple and intelligible form a body of geometric doctrine, acquaintance with which may fairly be demanded of candidates for the Freshman class" of the Missouri State University. It is shaped on the lines of such modern works as those by Newcomb, Halsted, and Dupuis, to refer to English text-books only; but it most nearly resembles in some parts the excellent little manual "on congruent figures," by Prof. Henrici. "The work asks to be judged, at least in its name, according to (the) spirit of modern geometry, and not according to the letter."

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It is hard at this date to write anything new on the subject of elementary geometry, and for the class addressed by the author it is not desirable, but the well-known facts may be treated in very diverse ways: in this case there is a novelty and freshness which must commend the treatment of them to all intelligent students. Take this "precise definition" of a plane: Take two points A and B and suppose two equal spherical bubbles formed about A and B as centres. Let them expand, always equal to each other, until they meet, and still keep on expanding. The line where the equal spherical bubbles, regarded as surfaces, meet, has all its points just as far from A as from B. As the bubbles still expand, this line, with all its points equidistant from A and B, itself expands and traces out a *plane* as its path through space. Hence we may define the *plane* as the region (or surface) where a point may be, that is, equidistant from two fixed points. . . It is evident that the plane, as thus defined, is reversible. . . The superiority of this definition consists in its not only telling what surface the plane is, but also making clear that there actually *is* such a surface. Thence our author readily derives the notion of the *ray* (anglicè, straight line: a *tract* being a part bounded by end-points).

This manner of illustration occurs repeatedly, and adds, we think, much to the interest of the book.

As a specimen of the mode of proof employed we take what is equivalent to part of Euc. i. 5. *Data.* ABC, an isosceles triangle, AB its base, AC and BC its equal sides (here we may remark the figure is badly drawn: a similar remark applies to figures on pp. 60 and 91). *Proof.* Take up the triangle ABC, turn it over, and replace it in the position BCA. Then the two triangles ACB and BCA have the equal vertical angles, C and C, also the side $AC = BC$ (why?) and $BC = AC$ (why?); hence they are congruent (why?), and the $\angle A = \angle B$.

In the more elaborate proofs there is a larger crop of "whys," and in some cases the interrogation is answered by the author.

The amount of ground covered is considerable, and yet, as we have gone through the whole of the text, it is so clearly opened up that the intelligent student, to whom we have previously referred, should be able to master it all, and successfully grapple with the well-chosen exercises which are arranged in fitting places throughout the book. "These exercises have been chosen with especial reference not so much to their merely disciplinary as to their didactic value, the author being persuaded that quite as good exercise may be found in going somewhither as in walking round the square."

We have no hesitation in heartily commending Prof. Smith's introduction to teachers and pupils as an excellent one, and this we vouch, adapting the language of the learned counsel cited by Bailie Littlejohn, *nostro periculo.*

Primer of Horticulture. By J. Wright. (London: Macmillan and Co., 1893.)

This primer contains the substance of ten lectures delivered by Mr. Wright for the Surrey County Council. Besides the lectures, some sets of questions, asked after the lectures, are given together with the answers to these questions.

The primer is eminently practical, and is sure to prove very useful both to gardeners and to students. It cannot, however, be considered quite free from errors, and a careful revision would increase its value.

Sometimes the text is rather loose.

On p. 54 the word *pistil* is used indefinitely, sometimes meaning the style and at others the whole gynœcium.

Speaking of phosphatic manures on p. 64 the author says:—

"Mineral superphosphate is ground coprolite treated with sulphuric acid.

"Coprolite is antediluvian petrified manure, of which there are large beds in the Eastern Counties. It is fairly active, yet sustaining.

"Thomas's phosphate powder, or basic slag— . . . . is composed of 15 to 25 per cent. of phosphoric acid and about 45 per cent. of lime. It is not very quick in action, but lasting in effect."

From this description one cannot get much idea of the relative values of these three phosphatic manures, and basic slag suffers by comparison with ground coprolite. Practical experience shows that basic slag has a much higher value than ground coprolite as a manure, and has, moreover, an additional value as a check upon wireworm.

Again, on p. 77, the description of the fungus causing potato disease (phytophthora infestans) is scarcely accurate. In describing the aerial hyphæ which spring from the mycelium in the leaves and push their way through the stomata, the author says:—

"These stem-growths of the fungus produce 'fruit'-spores (DD) in cells (Oogonia), that divide (F) and liberate the active agents in reproduction, tailed zoospores (G) which float in the air, and swim in the moisture, dew, or rain, on potato leaves." The letters in parentheses refer to fig. 18, p. 79. Neither text nor description below fig. 18 is correct. What Mr. Wright calls oogonia are really conidia, and what he calls conidia (F in fig. 18) represent the formation of an oospore from oogonium and antheridium. We must also dissent from the author's views on zoospores floating in the air.

Apart from these defects the primer is well worthy of perusal, and will no doubt meet with success. The practical part is very well done, and this is, of course, the most essential part of the book. Walter Thorp.

Ornithology in relation to Agriculture and Horticulture. Edited by John Watson. 220 pp. (London: W. H. Allen, 1893.)

This book contains a series of papers by well-known writers. The chief interest will gather around chapters iii. to vii. inclusive, which treat of the common sparrow. The trial of the sparrow is opened very ably by Mr. Chas. Whitehead (for the prosecution). He is well supported in the next chapter by Miss Eleanor A. Ormerod. These two writers for the prosecution will have the support of the vast majority of agriculturists in England, and their arguments contrast favourably with the less practical defence put forward in the two succeeding chapters by the Rev. F. C. Morris and the Rev. Theodore Wood.

Chapter VII. is written by J. H. Gurney, Jun., and from the result of 755 dissections he draws up a table showing that "in England about 75 per cent. of an adult sparrow's food is corn, chiefly barley and wheat, with a fair quantity of oats." Nobody with experience of grain-growing in England will deny that the sparrow is a terrible pest, and it is time that a movement be made not towards exterminating the troublesome bird, but towards reducing its numbers to normal limits.

Chapter IX. is an interesting defence of the rook, much of which defence this bird merits. It is written by O. V. Aplin, who also contributes a very useful chapter on miscellaneous small birds. Walter Thorp.

LETTERS TO THE EDITOR.

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Vectors *versus* Quaternions.

Having a vivid recollection of the pleasure I derived from Prof. Gibbs's attacks upon the quaternionic system in the rather one-sided discussion that took place about two years ago in this

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